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Research Product 85-17

TRAX II: Computer-Assisted Platoon Leader Tactical Training

ARI Field Unit at Fort Knox, Kentucky
Training Research Laboratory

April 1985

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18. (Continued)

Unit, enclosing a blank diskette, to receive the TRAX II materials and a copy of the software.

20. (Continued)

The list of controller tasks was examined to identify those tasks which could be more efficiently performed by a computer. Selected tasks were organized as screen displays. An input mode was selected which did not require the user to have strong typing skills. A user's manual was tested and revised.

Preliminary testing indicated that TRAX II is usable in its current form. Use of TRAX II allows gaming to be conducted without the Fire Controller required in TRAX I. TRAX II is available with TRAX I for more extensive field testing.

Research Product 85-17

TRAX II: Computer-Assisted Platoon Leader Tactical Training

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FOREWORD

Platoon and company leaders must make tactical decisions rapidly, often while under fire. The intensity and lethality of the modern battlefield demand that these leaders be well trained before entering battle.

Map and terrain board combat games can provide a useful transition from classroom instruction to field training. Combat games require the player/student to integrate tactical concepts and methods introduced in the classroom. Gaming provides practice of command, control, and communication. Combat games can be used to rehearse field exercises so that resources expended in field training are used to best advantage.

This report describes the development of a computer assisted version of the TRAX I combat gaming method. TRAX I was developed for tank platoon training based on Division '86 equipment and tactical doctrine. The computer-assisted supplement, called TRAX II, performs many of the control and record-keeping procedures.

The innovative techniques of play introduced in TRAX I, combined with the computer-assisted procedures of TRAX II, provide a combat gaming system which alleviates several of the problems associated with previously developed combat games. Rules are simple, play is fast, and controller costs are reduced.

The TRAX gaming method is suitable for tactical training at platoon and company level. The method used should be of special interest to those responsible for training officers and NCOs that lead armor units in active or reserve organizations. The novel techniques of play developed in TRAX should also be of interest to developers of military games for training, or those who use combat-simulation gaming in research and development work.



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TRAX II: COMPUTER-ASSISTED PLATOON LEADER TACTICAL TRAINING

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TRAX II: COMPUTER-ASSISTED PLATOON LEADER TACTICAL TRAINING

OVERVIEW

Trax I is a combat gaming method for tank platoon leader tactical training. Trax II is a set of computer programs designed to assist the Instructor/Controller during Trax I gaming sessions. Trax II is not a stand-alone, computerized version of Trax I or a replacement for Trax I. Trax II only modifies Trax I control procedures, and substitutes for some of the materials used by controllers.

Trax I was designed to allow the Student/Player to concentrate on those activities which would be performed in actual combat. The player is not required to deal with extraneous gaming tasks, such as using probability tables to calculate the results of simulated firing. Trax I uses carefully structured scenarios. Players are initially given meaningful orders and are then confronted with an integrated series of realistic situations. Player actions can be evaluated in relation to prescribed tasks, and the context of the overall mission.

The responsibilities of the controllers in Trax I are increased both by the transfer of some gaming tasks from the player to the controller and by the use of highly structured scenarios. Trax II is designed to allow the Instructor/Controller to concentrate on making each gaming session a valuable learning experience, and to avoid being delayed or distracted by the mechanics of the game and record keeping. While Trax I alone requires three controllers, the assistance provided by Trax II permits play with only two controllers.

OBJECTIVES

Five general, overlapping goals were identified for producing a computer-assisted version of Trax I:

- (1) Reduce the cognitive load of the controller: Display current game sequence and scenario conditions, and reduce the number of table look-ups required.
- (2) Ensure correct sequence of play: Maintain a sense of continuity of space and time throughout the entire scenario.
- (3) Keep records: Store information to assist after-action reviews and allow comparisons across different gaming sessions.
- (4) Speed play: Help the controller to enforce rapid completion of player actions, and reduce delays caused by controller actions.
- (5) Reduce controller costs: Decrease the number of controllers required and reduce the amount of controller training and practice needed.

PROCEDURE

Control of Trax I separates duties performed by the Instructor/Controller, an OPFOR controller, and a Fire Controller. The fire controller duties primarily involve entering tables to determine fire results, and locating and scheduling indirect fires. Most of these duties could be performed by the computer with limited controller inputs, suggesting that this position could be eliminated. Several Trax I gaming sessions were conducted in order to identify specific elements of controller tasks which could be implemented on a microcomputer. These selected elements were grouped into three categories: prompts, immediate commands, and procedural commands.

Prompts display information about the game sequence and the scenario event schedule. Prompts indicate the next actions to be performed by the controller.

Immediate commands perform some function without requiring additional controller input. An example is the command to increment the elapsed turn counter.

Procedural commands require the controller to provide additional information. An example is the command to resolve US direct fire, for which the controller must input range, target characteristics, and related information. The prompts, immediate commands, and procedural commands implemented in Trax II are presented in Table 1.

Table 1

Prompts and Commands

<u>Prompts</u>	<u>Immediate Commands</u>
Current step within turn	Increment step
Current turn	Increment turn
Status of US vehicle	
Remaining number of smoke salvos	Indicate smoke usage
"DUE" US indirect fire missions	
Current scheduled scenario events	Advance event list
<u>Procedural Commands</u>	
US direct fire	
OPFOR direct fire	
US indirect fire	

In addition procedures were included to:

- (1) Display ammunition usage by US tanks.
- (2) Display a chronological record of direct fire, indirect fire, and smoke usage.
- (3) Display the complete scenario event list.
- (4) Provide a printout of the three procedures listed above.

IMPLEMENTATION

Hardware

Due to limited funding and time constraints the decision was made to use only equipment which was already available at the ARI Fort Knox Field Unit. This decision greatly limited the design of the Trax II system. The final hardware configuration included an Apple II Plus microcomputer, a TSD touch screen, an NEC monitor, and an Epson MX80 printer.

Software

Separate program modules were written to handle the Prompt page, US direct fire, OPFOR direct fire, and US indirect fire. Subsequent field testing may indicate ways to improve one or more of these modules. Changes can be more easily implemented if the modules are maintained as separate sub-programs. When major changes are no longer required the individual modules can be integrated to produce a more efficient, smaller and faster, program. Problems associated with interfacing the touchscreen with the Apple II Plus produced several limitations in the design and operation of the Trax II system. These limitations were (1) the required use of the relatively slow Applesoft Basic programming language and, (2) the inability to compile the program. An assembly language subroutine, which was written by Mr. Fred Ahrens for a previous application, was modified to pass coordinates from the touchscreen to the Trax II main program. The main program could not be compiled because of the form of the instructions needed to call the assembly language subroutine. Compilation would produce a significant increase in the speed of operation of the main program.

DIALOGUE DESIGN

Williges and Williges (1984) have surveyed many factors which are important in the design of interactive computer systems. The relevant factors for the Trax II system are (1) input device mode, (2) dialog mode, and (3) feedback and error handling.

Input Device Mode

Input device mode was considered to be the most important consideration in the design of Trax II. It could not be assumed that the user would be an

experienced typist, and it was desirable to avoid the need for lengthy training and practice sessions. Therefore, the touch screen was selected as the primary means for information input. Telesca (1984) has listed several advantages of touchscreen input. Touch screen input can be faster and have a lower error rate than keyboard entry, it allows direct hand/eye interaction and requires no additional desk space or other devices.

Dialog Mode

All of the prompts and immediate commands were organized as a single page display. US direct, OPFOR direct fire, and US direct fire were each presented on separate pages. "Confirm" options were used with the longer procedural commands so that the user could selectively change or delete individual options without being required to reinput other information.

Scharer (1983) has pointed out that live demonstrations and personal interaction are often considered the most useful elements of a training period. Neither of these options will be available to the Trax II end-user, therefore, particular care was given in writing the Trax II user's manual. Four naive users tested the manual. After each test the manual was revised according to the user's comments, suggestions, and observed errors.

Feedback and Error Handling

The touchscreen does not always detect "touches." To avoid confusion caused by detection failures, the Trax II program was modified so that a "click" sound is produced after a detected "touch."

Error messages were designed to describe the cause of error and indicate the corrective action to be taken. Considerable effort was devoted to provide an error trapping system to avoid system crashes. Trax II has no procedure for recovery after a crash.

RESULTS

Trax II was pilot-tested with one Trax I scenario and a military officer as Instructor/Controller, and a staff member as OPFOR Controller. The Instructor/Controller had little difficulty in operating the program and controlling play. Elimination of the fire controller and inputs by the Instructor Controller appeared to require only infrequent and slight delays in the rate of play.

CONCLUSION

The Trax II program is workable in its current form and is available together with Trax I for more extensive field testing. If sufficient demand for this research product is indicated it would be worthwhile to assemble a more suitable hardware configuration, and to produce a faster and more structured revised version of the software.

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APPENDIX A

TRAX II

COMPUTER-ASSISTED SUPPLEMENT FOR THE TRAX GAMING SYSTEM

TRAX I is a manual combat game for training tank platoon tactics based on Division '86 equipment and doctrine. TRAX II is a computer-assisted supplement which is used with, but does not replace, TRAX I.

Five general, overlapping goals were identified for producing a computer-assisted version of TRAX I:

(1) Reduce the cognitive load of the controller: Display current game sequence and scenario conditions, and reduce the number of table look-ups required.

(2) Ensure correct sequence of play: Maintain a sense of continuity of space and time throughout the entire scenario.

(3) Keep records: Store information to assist after-action reviews and allow comparisons across different gaming sessions.

(4) Speed play: Help the controller to enforce rapid completion of player actions, and reduce delays caused by controller actions.

(5) Reduce controller costs: Decrease the number of controllers required and reduce the amount of controller training and practice needed.

TRAX II is designed to assist the Instructor/Controller during gaming sessions. The user should be familiar with the Controller's guide before attempting to use the TRAX II User's Manual. This manual presents step-by-step instruction on the use of TRAX II and should be read before an actual gaming session is started.

TRAX II requires:

Apple II Plus microcomputer

One disk drive

Monitor equipped with a TSD touch panel (slot #5)

Optional: Epson MX 80F/T printer (slot #1)

TRAX II USER'S MANUAL

Start

Place the Trax II diskette into disk drive I, carefully close the drive door, and then turn on the Apple II, the T.V. monitor, and the touch screen (See Figure 1). Turning on the Apple II automatically loads the Trax II program. After a few minutes, the available scenarios will be listed. Select one scenario by typing the appropriate number key at the top of the Apple terminal keyboard, do not hit the return key. The disk drive will run intermittently for several minutes before the *CONTINUE option will appear. Please read the next section before using the touch screen.

Touch Screen

The Trax II options that are frequently used during a gaming session are activated by lightly tapping or pressing the touch screen. The touch screen is a delicate film which covers the surface of the monitor screen. Always use a soft stylus, such as a pencil eraser, to tap or press the touch screen. Use of excessive pressure or sharp objects will permanently damage the touch screen.

Each of the Trax II commands which can be selected with the touch screen is identified by the symbol "*" which appears to the immediate left of the command. To activate that command press directly over the * on the screen. Always press briefly, continued pressure on the touch screen will produce

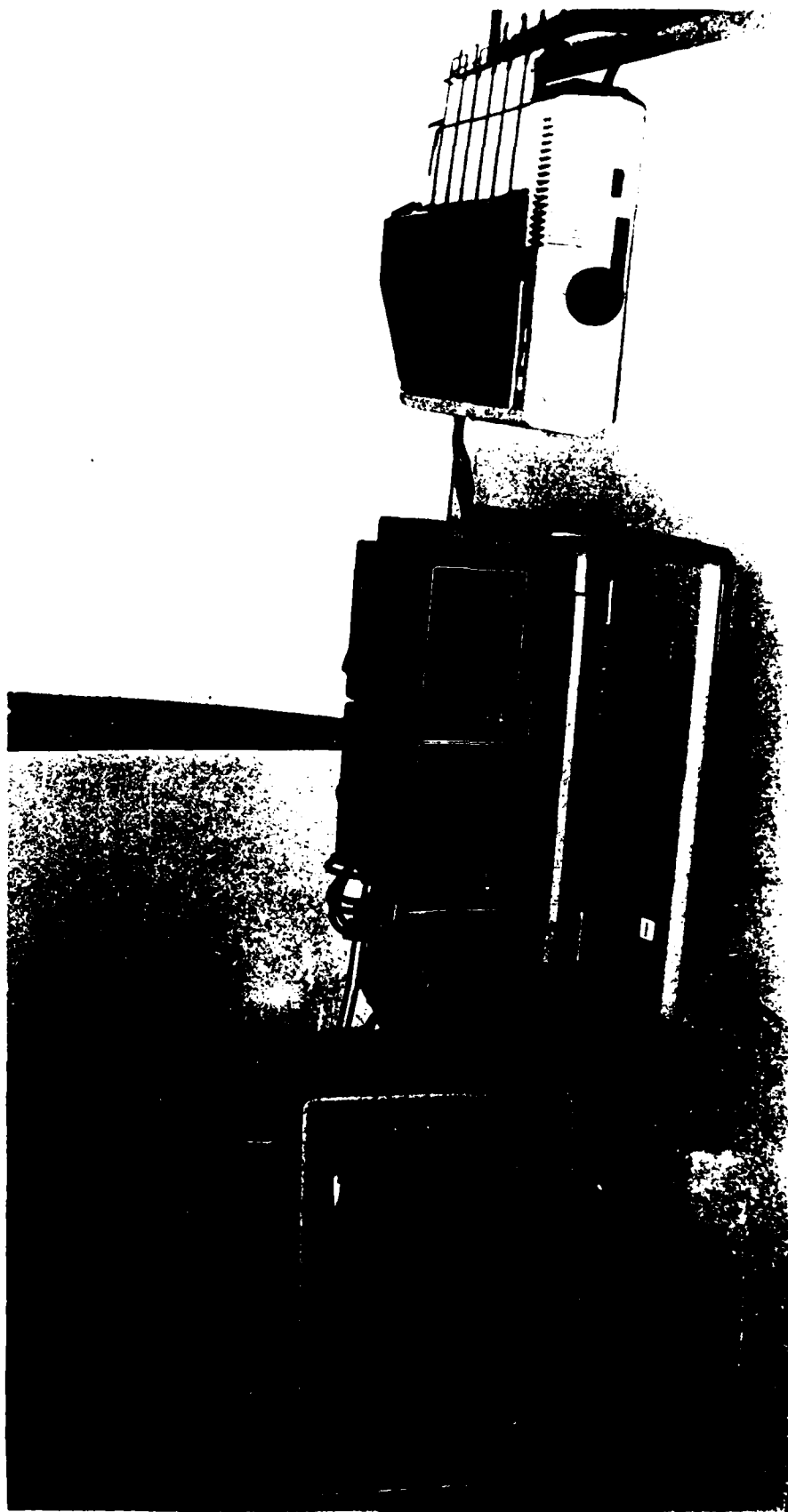


Figure 1. Monitor and touch screen, Apple II Plus, printer (optional).

unwanted results. When the program calls for information from the touch screen the keyboard is disabled and when the keyboard is enabled the touch screen is disabled.

CONTINUE Option

Note the *CONTINUE option at the bottom of the screen. This option allows the controller to examine the information on the screen, or as is the case here, to pause until ready to continue. No other commands are operational when *CONTINUE appears.

Press the * in *CONTINUE. (Using the pencil eraser, lightly press the * on the screen. A buzz will be heard when the screen is properly touched.) The Prompt page should now appear.

Prompt Page (See Figure 2)

The Prompt page contains the most frequently used gaming options, therefore most of the other pages automatically return to the Prompt page. The scenario title and the turn counter are at the top of the page. Below these are the status indicators for each of the four US tanks.

Note the row labelled POP. This row lists the number of smoke grenade salvos remaining for each tank. The * next to each number on this row indicates a sensitive area of the touch screen. Press the * to indicate that a particular tank has "popped" smoke. The smoke counter should decrease by

	TRM1				TURN 0
TANK#	1	2	3	4	
STATUS	UP	UP	UP	UP	
POP:	*2	*2	*2	*2	*RELOAD
*NEXT STEP	STEP 0				PLACE YOUR CARDS
*NEXT TURN					*US DIRECT FIRE
					*OPFOR DIRECT
*NEXT EVENT					*INDIRECT FIRE
EVENT	CONDITION				
0					*MAIN
1	TACTICAL ROAD MARCH 1				

Figure 2. Prompt page.

one. To indicate that a tank's grenade launchers have been reloaded, press the *RELOAD option (which should flash) and then press the corresponding * for that tank. The number will increase, indicating loading. The maximum load is 2, the minimum is zero. Press *RELOAD again to turn off the reload option.

Below POP is the *NEXT STEP command. This cycles through the list of steps. Step 0 is a reminder for the controller to instruct the players to select and place action cards at the beginning of a new turn. Each of the next five steps lists the cards that are eligible for action for that particular step. Step 6 indicates that calls for indirect fire can be made during this step. If a previously called indirect fire mission is due to impact on the present turn, the INDIRECT FIRE step label will flash and the mission(s) due will be listed under the *INDIRECT command. (The markers indicating impacting indirect fire should be placed on the terrain board during this step.) The next step reminds the controller to announce the Command Commo phase. Pressing *NEXT STEP after Command Commo produces the message NEXT TURN, indicating that this turn is over and that the controller should press the *NEXT TURN command. As each scenario event is played out, the controller should press the *NEXT EVENT command to update the scenario event prompts.

US Direct Fire, OPFOR Direct Fire, and US Indirect Fire are separate pages that can be called from the Prompt page. These pages operate in a different manner than the Prompt page. With the Prompt page, individual commands are selected and some immediate result occurs. For these other

pages, several items of information must be specified and then a *SEND PAGE command is given. Before the *SEND PAGE command is given any of the options on that page can be changed or corrected.

DIRECT FIRE (See Figure 3)

Press * US DIRECT FIRE

To resolve US direct fire, five items of information must be specified. One, and only one, item should be selected from each of these five categories.

1. Attacker #. The identification number of the firing U.S. tank.
2. Weapon system. The main gun (105) or machine gun (MG).
3. Ammo. The type of ammo being fired from the main gun. If MG has been selected in 2 above, then the type of machine gun, 50 cal or COAX, must be specified.
4. Target. Tank (heavy armor targets), APC (all light armor targets and choppers), or Troops.
5. Range. The range category that best matches the range from attacker to target as measured on the terrain board.

	TURN 0			
ATTACKER#	*1	*2	*3	*4
WEAPON:	*105		*MG	
AMMO:	*APOS		*HEAT	*APFSDS
TARGET:	*TANK		*APC	*TROOPS
RANGE:	*500	*1000	*1500	*2000
	*2500	*3000	*3500	*4000 *>4K
FIRER::	*MOVING	*STAB IN		*2nd ROUND
		*COVERAGE IN		*RECON BY FIRE
TARGET::	*MOVING	*HULLDOWN	*FLANK	*REAR
	*T-64/72		*PREP POS	*T-62
	*SEND PAGE		*ERASE	

Figure 3. US direct fire.

Example.

Tank #1 fires HEAT at a SAGGER signature in the woods at 1500 meters.

Press *1 on the Attacker# row. *1 should now flash.

Press *105

Press *HEAT

Press *Troops (Notice that the Target:: options
change on the lower half of the page)

Press *1500 for the range category.

If *SEND PAGE is pressed before the five necessary items of information have been selected, a 'beep' will sound and an error message will appear at the bottom of the page, prompting for the missing information. For example, if no attacker # is specified, or, if more than one are specified, the message "ERROR Attacker #" will appear.

When the basic required information has been provided, *SEND PAGE can be used. However, for added realism and for increased player interest, several other factors should be specified.

The factors listed below the range categories are optional. The ways in which they influence fire resolution are listed in the Direct Fire section of the Controller's Guide.

"*COVERAGE IN" is automatically turned on (indicated by flashing). If no targets are in the effective radius of the point of aim then "*COVERAGE IN" should be turned off, by pressing it. Refer to the discussion of firing on hidden targets in the Direct Fire section of the Controller's Guide.

For this example, assume that Tank #1 is firing on the move with the stabilizer on. In the row Firer:: press *MOVING and *STAB IN. For the Target:: rows press *SAGGER and *WOODS/BUILDING. (Note that for categories marked with :: it is often appropriate to select more than one option per row. For example, for Firer:: all three options may be operational (flashing) at one time.)

Now press *SEND PAGE

After several seconds the firing result will be listed.

Pressing *CONTINUE calls the Prompt page.

Since many successive direct fires are similar, the Direct Fire page maintains the settings from the previous firing.

Press *US DIRECT FIRE

Assume that tank #1 also fires 50 cal at the Sagger position. Press the flashing *105 to turn it off. Then press *MG. Always turn off one option before turning on an alternate choice. Pressing *MG changes the row below it. After the row changes, press *50 cal. The range categories will now change. Select the appropriate range category, 1600.

Now press *SEND PAGE.

Instead of changing options by turning the previous selections off and turning the new on, *ERASE can be used to turn off all options. Pressing *ERASE and then again pressing *ERASE will call the Prompt page. This option of hitting *ERASE twice as a way to return to the Prompt page without completing a call for fire works for US Direct fire, Indirect fire, and OPFOR Direct fire.

Press *CONTINUE

OPFOR Direct Fire

OPFOR Direct fire (See Figure 4) is very similar to US Direct fire. Note that the first row calls for the identification number of the US tank which is the target of the OPFOR fire.

Press *OPFOR Direct fire on Prompt page.

TARGET#	*1	*2	*3	*4
ATTACKER:	*115MM		*125MM	
	*76MM		*73MM	
	*SAGGER		*RPG	
RANGE:	*500	*1000	*1500	*2000
	*2500	*3000		*>3K
FIRER::	*MOVING	*STAB IN	*2ND ROUND	
	*COVERAGE IN		*RECON BY FIRE	
TARGET::	*MOVING	*HULLDOWN	*FLANK	*REAR
	*SMOKE	*PREP POS *EVASIVE		
	*SEND PAGE	*ERASE		

Figure 4. OPFOR direct fire.

Example:

RPG fires at US tank #2 from 100M.

Press *2

Press *RPG

Press *100

Press *SEND PAGE

Press *CONTINUE

Indirect Fire

From the Prompt page:

Press *INDIRECT FIRE (See Figure 5)

For every call for fire three items of information must be specified:
type of call, ammunition, and the grid coordinates.

TURN 0					
INITIAL					
CALL:	*TRP	*OPPORTUNITY			
	*IMMEDIATE	*FPF			
ADJUST	*SHIFT <400	*SHIFT >400			
AMMO:	*HE	*SMK	*HE+SMK	*ILL	*SIG
*ENTER GRID					
#	TYPE	AMMO	GRID	ERROR	TURN
*SEND PAGE			*ERASE		

Figure 5. US indirect fire.

Type of Call

There are many methods of calling for indirect fire. Some examples are grid coordinates, polar coordinates, and shift from a known reference point. For the purposes of this program, a call for fire must be classified as representing one, and only one, of six categories.

1. TRP (Target Reference Point)
2. Opportunity
3. Immediate (this applies for either "immediate suppression" or "immediate smoke").
4. FPF (Final Protective Fire)

When US indirect fire is placed on the terrain board it will often not fall exactly where the Platoon leader intended. Any subsequent shift from the point of impact should be classified as:

5. SHIFT <400 A shift of 400 meters or less
6. SHIFT >400 A shift of more than 400 meters

Every call must be classified according to one, and only one, of the above six categories. The type of call will determine how many turns it takes for a call to arrive, delay, and the range and deflection error. (See Table 1).

Table 1

U.S. Indirect Fire: Delay and Error

<u>CALL</u>	<u>DELAY (TURNS)</u>	<u>MAXIMUM ERROR (METERS)</u>	
		DEFLECTION	RANGE
TRP	2	200	300
OPPORTUNITY	5	200	300
IMMEDIATE	1	400	600
FPF	2	0	0
SHIFT <400	1	200	300
SHIFT >400	2	200	300

Note: FPF is treated as a special case. Ammunition and grid coordinates need not be specified. *SEND PAGE can be used immediately after *FPF is pressed.

Ammunition

One, and only one, of the five categories of ammunition must be specified.

HE: High Explosive

SMK: Smoke

HE+SMK: High Explosive and Smoke

ILL: Illumination

SIG: Signal

GRID Coordinates

Regardless of the method used by the player to call for indirect fire, the Controller must convert the call to the six digit grid coordinate system! These six digits must be typed from the keyboard.

To shift from touchscreen mode to keyboard mode use *ENTER GRID. The words "(USE THE KEYBOARD)" will appear to the right of the grid box. This indicates that the program is ready to receive 6 digits, typed one at a time without using the return key. Six digits must be typed before the program will accept any other commands. When the sixth digit is typed, the words "(USE THE KEYBOARD)" will disappear, indicating that the touch screen mode is again in effect. If a mistake is made in typing the digits, hit *ENTER GRID again and type the correct six digits. Six digits must be entered before corrections can be made.

Example.

The platoon leader calls for immediate suppression of grid
593240.

Press *IMMEDIATE

Press *HE+SMK

Press *ENTER GRID ("USE KEYBOARD" will appear)

Type (from keyboard) 593240

After type of call, ammunition, and grid coordinates have been specified, the command *SEND PAGE will produce a summary of the mission.

Press *SEND PAGE.

Reading from left to right, the number of the mission called, the type of call, the ammunition, and the original grid coordinates are listed. Next is the deflection and range error. This error will be automatically added to the original grid coordinates. Finally, the turn number on which the present call is due to impact is listed.

Occasionally, more than two fire missions will be due to impact during one turn. When this occurs the program automatically adjusts the schedule so that no more than two missions will impact during a single turn.

Press *CONTINUE

The Current Schedule page lists all US calls for indirect fire. Missions that were due on turn numbers that have already elapsed are marked with an "X".

Press *CONTINUE

On the turn during which a mission(s) is due to impact, a description of that mission will appear on the Prompt page under the *INDIRECT FIRE command. The *INDIRECT FIRE command should be used only when the player is calling for a mission. Missions that are due are automatically listed on the Prompt page. Remember that the grid coordinates listed on the Prompt page already have the deflection and range error added in.

Main Menu

In the lower right corner of the Prompt page is the *MAIN command, this calls the Main menu. The Main menu lists options which will usually be used just before or during the after-action review. These options may be called during the gaming session. They are selected by using the keyboard, not the touchscreen.

1. Return to Prompt. Return to the Prompt Page.
2. Fire Record. Chronological listing of direct and indirect firing and smoke usage.
3. Ammo Usage. Breakdown, by individual tanks, of ammunition use.
4. Scenario Event List. Complete list of scenario events.
5. Printer. Provides printout of above options. (Printer must be on)
6. End. Terminate program.

Figures for TRAX II

- 1) Equipment Configuration
- 2) Prompt Page
- 3) US Direct Fire
- 4) OPFOR Direct Fire
- 5) US Indirect Fire